German Government Perspectives on Hydrogen at Ports and At-Sea Marine Applications

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H2@Ports Workshop
Sept. 10, 2019 | San Francisco, CA
TOWARDS ZERO EMISSION MOBILITY
Integrated implementation of national funding programs by NOW GmbH

National Innovation Program for Hydrogen and Fuel Cell Technology (NIP)
Research & Development; Procurement

Export Initiative for Environmental Technologies

Electric Mobility on Site
Research & Development, Procurement, Concepts

Charging Infrastructure for Electric Vehicles
Nationwide Establishment of Regular- and Fast Charging Points

Mobility and Fuel Strategy
Pilot Projects
LNG in Shipping

Coordination
Implementation
Networking
Acceptance
Visibility
GERMAN GOVERNMENT PERSPEKTIVE

Current German Government’s coalition agreement:

„At national level, we want to strengthen and stabilize our technology-open initiatives for alternative propulsion and energy sources in shipping and in ports (LNG, Hydrogen / fuel cell, methanol, electromobility).“

=> Technology-open, but focus on H₂ & Fuel Cells, Methanol, Electromobility

Current funding initiative:
National Innovation Program for Hydrogen and Fuel Cell Technology (NIP)
# Fuel Cells in Ships - NIP R&D Projects 2009 – To Date

*e4ships Project Cluster* - [www.e4ships.de/english-1/](http://www.e4ships.de/english-1/)

<table>
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<th>SchIBZ2</th>
<th>MultiSchIBZ</th>
<th>Pa-X-ell</th>
<th>RiverCell</th>
<th>ELEKTRA</th>
<th>FC Ship Propulsion</th>
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<tr>
<td><strong>Project Management:</strong></td>
<td>ThyssenKrupp Marine Systems</td>
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<td>Meyer Shipyard</td>
<td>Meyer Shipyard</td>
<td>TU Berlin</td>
<td>Humphry Marine</td>
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<tr>
<td><strong>Application Area Focus:</strong></td>
<td>Sea</td>
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<td>Inland</td>
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<td><strong>Application Focus:</strong></td>
<td>Multi Purpose Vessels, Yachts</td>
<td>Multi Purpose Vessels, Yachts</td>
<td>Cruise Ship</td>
<td>River Cruise Ship</td>
<td>Tug Boat</td>
<td>Leisure Boat</td>
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<tr>
<td><strong>Fuel:</strong></td>
<td>Diesel</td>
<td>Diesel; LNG</td>
<td>Methanol; LNG</td>
<td>Methanol</td>
<td>H₂</td>
<td>H₂</td>
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**ELEKTRA PROJECT**

Example for Ship and Port Operation with Fuel Cells

**Main Dimensions**
- Length: 20,00 m
- Width: 8,20 m
- Depth: 1,25 m
- Weight: ca. 150 t

**Propulsion**
- 2 x 210 kW
- 3 x 100 kW Fuel Cell
- 750 kg H₂ on board
- 2 x 1025 kWh Battery

**Range extended operation**
- Berlin <-> Hamburg, Berlin <-> Stettin
- min. range 130 km per day
- 16 h of operation per day
- speed requirement 8,5 km/h, max. 10 km/h

Local transport within Berlin
LESSONS LEARNED ON EARLY FUEL CELL MARITIME PROJECTS
„Alsterwasser“ – Sightseeing Passenger Ship in Hamburg
Operational: 2008 – 2013 (no NIP-Project)

Lessons learned:
• Application and Infrastructure MUST go together
• Cost have to be lowered
• Although the project was a success, it didn´t cause a „rush“ on fuel cells in maritime applications
TO ADDRESS LESSONS LEARNED

Study „Renewable Energy for Fuel Cells in Inland Vessels“ – to be published ~ November 2019

➢ Identify „germ cells“ for fuel cells in ships by matching:
  • renewable energy sources
  • frequented shipping routes
  • port locations
  • cities with high emissions

➢ TCO analysis for various ship types and various renewable fuels

➢ Use study to educate relevant stakeholders about the technology
TECHNOLOGICAL CHALLENGES

Stack & System:
- still R&D needed for SOFC- and HT PEM- fuel cells as well as for reformer technology
- not many technological gaps for H₂ and PEM fuel cells => it works, high TRL

Infrastructure and Fuels:
- local and global availability of H₂ and other alternative fuels
- H₂:
  - pressurized, cryogenic, LOHC?
  - pressure level (350, 500, 700 bar)?
  - interface to refueling station
  - safe and low cost refueling procedure
  - standardization

Applications:
- individual design and construction of ships and fuel cell propulsion systems => economies of scale hard to achieve as in other traffic-sectors (i.e. FC cars, busses, heavy duty,...)
- lack of port-specific applications (push-trucks, heavy duty lift trucks,...)
REGULATORY CHALLENGES AND BARRIERS RELATED TO SAFETY, CODES AND STANDARDS

Activities of the e4ships – projects concerning safety, codes and standards are bundled by e4ships-Cluster-Management:

- Development and proposal of regulations for seagoing- and inland- vessels
- Communication with Flagstate

e4ships’ IMO Roadmap for maritime application of fuel cell
Thank you for your attention!

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